Stability of Microcatheter for Cerebral Aneurysm Embolization after Steam Shaping

T. ABE, M. HIROHATA*, N. TANAKA, Y. UCHIYAMA, H. MORIMITSU*, N. FUJIMURA*, Y. TAKEUCHI*, K. KOJIMA, N. HAYABUCHI

Department of Radiology, Kurume University School of Medicine; Japan
**Department of Neurosurgery, Kurume University School of Medicine; Japan*

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Summary

To compare the performance of stability after steam shaping on 4 types of microcatheters, which are commonly used for cerebral aneurysm embolization, an experimental simulation was performed. Distal portion of the microcatheters were shaped into the 90 degree with length of 5 mm with the steam under the instruction of each catheter.

In the temperature kept water bath, the change of the angle of the catheter tips were recorded and measured. Several stresses were added to the tips with coaxially passing through the guiding catheter, using guidewire and Guglielmi detachable coil (GDC).

The degree of straightening was prominent on braided microcatheters and on the short length of shaping. The degree of recover of the primary shaping was prominent on non-braided catheter. The most influence factor of straightening of shaped catheter tip was the stress from the manipulation of guidewire.

The influence from the inserting GDC was less than the guidewire manipulation. It was shown that the decreased angle after large stress was recovered under the situation of without or with small stress. Our study shows that the non-braided microcatheter was suitable when stability of microcatheter tip after steam shaping was requested for aneurysm coiling.

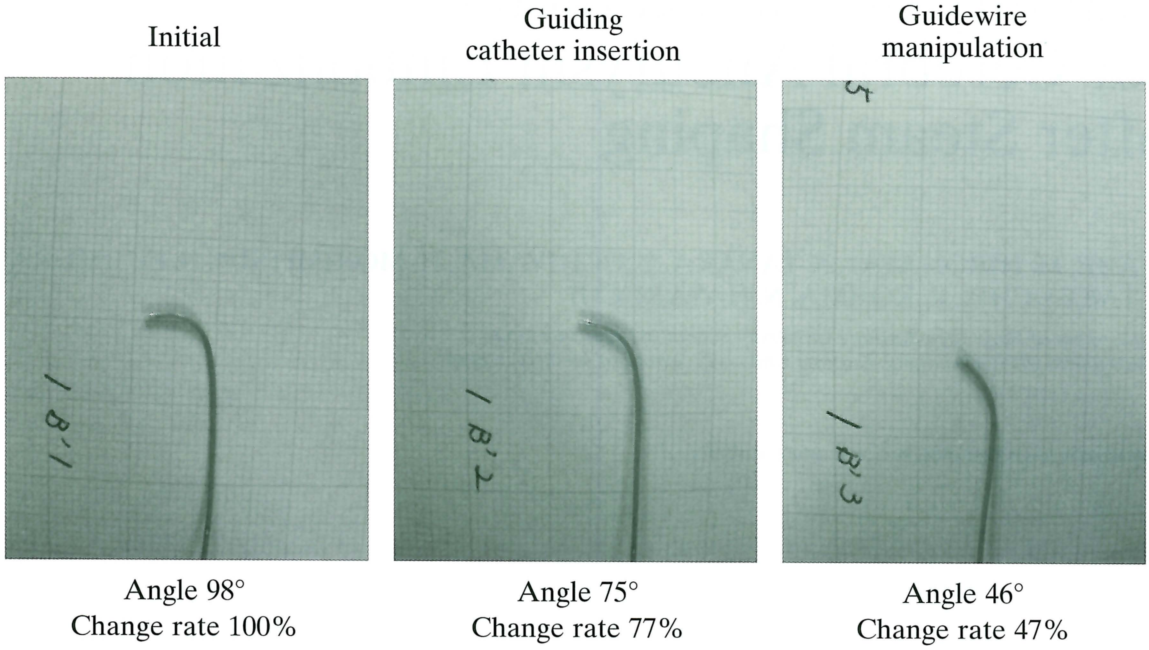
Introduction

The access of catheter tip into the dome of aneurysm depends on not only for the anatomical situation of the aneurysm and operator's technique, and also the performance of microcatheter, guidewire and guiding catheter. In the performance characteristics of microcatheter curving with steaming (steam shaping), the shortening of distal 3 centimeter of the catheter was reported [1]. However, the evaluation of the stability of curved catheter did not performed previously.

Methods

In this experimental simulation, currently available microcatheters for GDC-10 system were selected for test. Catheters tested include the FasTracker 10 (Target Therapeutics / Boston Scientific, Fremont, CA), Excel 14 (Target Therapeutics / Boston Scientific, Fremont, CA), Excelsior SL 10 (Target Therapeutics / Boston Scientific, Fremont, CA), Prowler 14 (Cordis Endovascular Systems, Miami, FL). All test catheters were obtained from commercially available stock at randomly.

6F Guiding catheters and 0.014-in. Transend floppy guidewires (Boston Scientific, Fremont, CA) were used. Used GDC system was GDC 10 SR in size of 6 mm in diameter and 6 cm



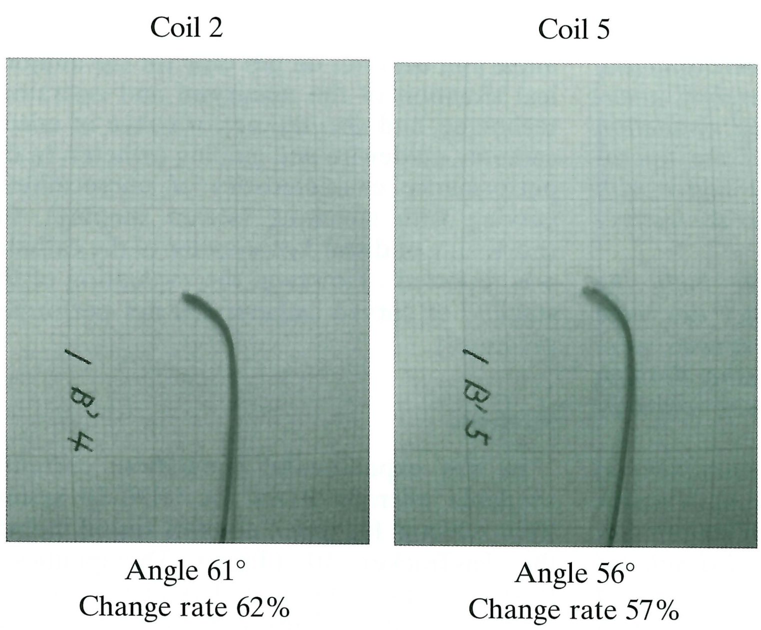


Figure 1 An Excel 14 catheter is demonstrated; 90 degree-angle form was manually steam-shaped. Although the initial measured tip-angle measured 98 degrees, the tip-angle decreased to 75 degrees following coaxial microcatheter insertion through a guiding catheter. The tip-angle was further reduced to 46 degree following guide wire manipulation. The tip-angle recovered to approximately 60 degrees after the second and fifth GDC withdrawals GDC insertions. The change rate of the catheter-tip angles, once exposed to straightening forces, was showed as a percentage straightening when compared with the initial baseline shaped angle.

length. These guiding catheter, guidewire and GDC system were used throughout all this study of microcatheter testing. All testing was performed using a digital temperature controlled water bath with a heat pomp (37° C).

Shaping of distal portion of catheter with steam was performed under instruction of each manufacturer. Angle of the catheter was set 90 degree and the length was set 5 millimeter, manually. Angle of the catheter was recorded on the 1 mm squared paper by a digital camera (figure 1). Angle was measured manually with

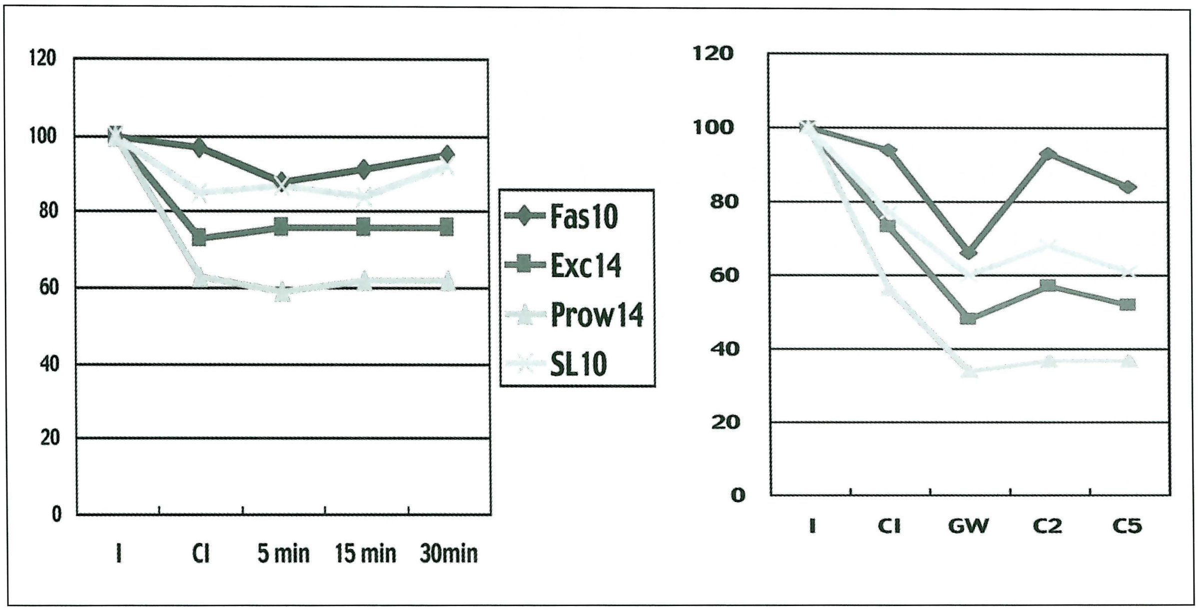


Figure 2 Change rate without stress on 5 mm length of steam shaped catheter tip are demonstrated. After insertion through a guiding catheter, measurement was performed at 5, 15, 30 minutes. Change rate with stress on 5 mm length of steam shaped catheter tip are demonstrated. I, initial measurement; CI, coaxial microcatheter insertion through a guiding catheter; GW, microguidewire manipulation; C2, after second GDC insertions and withdrawals; C5, after fifth GDC insertions and withdrawals; Fas10, FasTracker 10; Exc14, Excel 14: Prow14, Prowler 14; SL10, Excelsior SL 10.

Scion Image software (Scion Corporation, Frederick, Maryland).

The change rate of the angle was demonstrated with percentage from the initially shaped angle.

All microcatheters were inserted with guidewire through the guiding catheters, which were set into the temperature controlled water bath. In a group of without stress, angle was measured at 5, 15, 30 minutes after initial setting. There were two type of stress. One was given by guidewire, which obtained ten times of pass through and remain 30 seconds then withdraw approximately 10 cm and remain 30 seconds. And the other was given by GDC, which obtained totally five times of pass through and stay 5 minutes then withdraw. Angle measurements were performed at the time of after second and fifth withdraw of GDC.

Results

The change rates after insert into the temperature controlled water bath were observed. After pass through a guiding catheter with guidewire, the reductions of angle were observed.

The reduction rate was less in non-braided catheter than braided catheters. Prowler 14 had less stability than other catheters.

The largest reductions of angle were observed after guidewire manipulation and the righting moment to the original angle were shown during coil manipulation. The reduction rate was less in non-braided catheter than braided catheters. Non-braided catheter had better righting moment than braided ones. Prowler 14 had less stability than other catheters.

Discussion

To make a stable position of the catheter tip in the cerebral aneurysm, the distal portion of microcatheter were steam shaped frequently in the clinical condition. Previously, the stability of tip of microcatheter after steam shaping for aneurysm coiling was not unclear. The changes of shape after coiling procedure were frequently observed, clinically. However, the influence and causative factor were not reported.

On our small series of experimental study, it seemed that the large influence of angle reduction was guidewire manipulation. And the coil manipulation did not only influence of angle reduction, but also make righting moment possible.

Short length and acute angle shape may tend to return to the original straight form. Our study shows that the non-braided microcatheter was suitable when stability of microcatheter tip after steam shaping was requested for aneurysm coiling.

References

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Toshi Abe, M.D.
Department of Radiology
Kurume University School of Medicine
67 Asahi-Machi, Kurume, 830-0011, Japan